AGRICULTURAL ENGINEERING

THE JOURNAL OF THE

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Published at the headquarters of the Society, St. Joseph, Michigan

Issued monthly. Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year, 20 cents a copy. Postage to Canada, 50 cents additional; to foreign countries, $1.00 additional. Entered as second-class matter, June 25, 1921, at the post office at St. Joseph, Mich., under the Act of Aug. 24, 1921. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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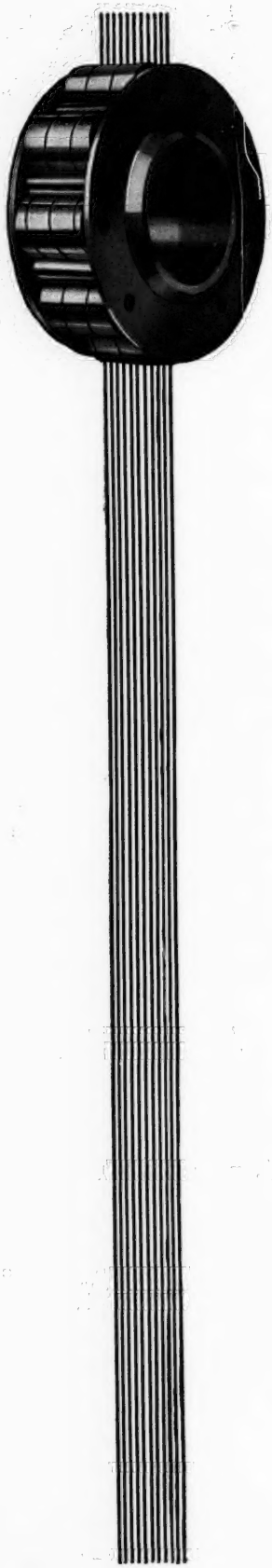

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Volume 3 FEBRUARY, 1922 Number 2

Removing Dockage From Wheat at the Thresher*

By Robert H. Black

Mem. A.S.A.E. In charge of the Minneapolis office of Grain Cleaning Investigations, U. S. Department of Agriculture

ONE of the principal agricultural industries of the world is the growing of wheat. The United States produces about 800,000,000 bushels of wheat each year and about one-third of this, or over 250,000,000 bushels, is spring sown. Most of the spring sown wheat, or about 200,000,000 bushels, comes from the states of Minnesota and North and South Dakota.

This part of the spring wheat district has for many years produced grain containing an abnormal amount of weed seeds. The official grain standards of the United States for wheat designate such weed seeds as can be removed readily from the wheat by the use of appropriate sieves, cleaning devices, or other practical means, as "dockage." When wheat is sold on the market, the weight represented by the dockage is deducted from the total gross weight before payment is made for the wheat.

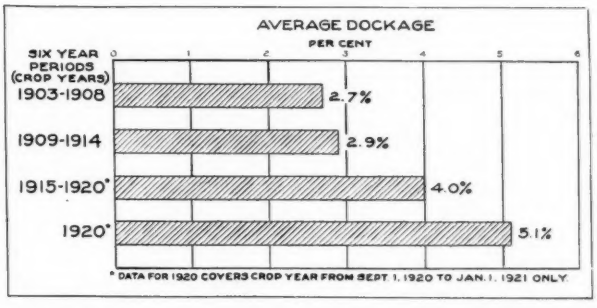
The Minnesota grain inspection records for the past 18 years show that the percentage of dockage in wheat arriving at terminal markets has been increasing. The average dockage for 1903 was 2.2 per cent; the average dockage for the six-year period ending 1914 was 2.9 per cent; and for the six-year period ending 1920 was 4 per cent, while for the 1920 crop of wheat alone marketed up to January 1, 1921, the average dockage was 5.1 per cent. This means that on this basis the 1921 crop of spring wheat contains over 10,000,000 bushels of 60 pounds each of dockage.

Some of the material removed as dockage has a certain feed value, while other constituent parts of the dockage not only have no feeding value but are actually harmful as a feed. The expense of removing the dockage at the elevators and flour mills at the present time practically offsets this commercial value, with the result that the farmers seldom receive anything for the dockage when they sell grain at their local elevators.

Dockage gets into the wheat from various sources. One of the principal sources is the sowing of foul wheat just as it comes from the threshing machine without any further cleaning. In order to determine just how much foul matter was being sown with the wheat, samples of seed wheat were taken from many of the drills which were seeding in the fields of Minnesota and the Dakotas last spring. On analyzing these samples it was found that a few were almost entirely free from weed seeds, but that the average amount of weed seeds sown with the wheat was over 2 per cent of the weight of the seed wheat. Many of the samples contained over 10 per cent of weed seeds and one sample of wheat being seeded contained as much as 18 per cent of weed seeds. In terms of numbers of weed seeds sown the range was from 2,000 to 489,000 weed seeds per acre, each of which was probably capable of developing a strong weed plant. Wild oats, wild buckwheat, vetch, and kinghead, in the order named, were the four weeds most common in the seed wheat. If the farmers insist upon sowing the seed as it comes from the threshers without further cleaning, then the threshers should clean the wheat much better than is now being done.

The weed seeds that are in the threshed wheat must be removed before the wheat is ground into flour. Removing these seeds at the flour mills is not only expensive but is also economically wasteful for many reasons, one of which is that the repeated handling of wheat through the elevators and during shipments breaks up many of the wheat kernels. These small pieces of cracked wheat, which would make good flour if they could be saved, are removed with the weed seeds when the wheat is cleaned in the flour mill, because the small pieces of cracked wheat are approximately the same size as the weed seeds and are removed in the cleaning operation.

A greater economic waste is due to the expense of handling the dockage itself. At the present time the farmers in the central northwest haul this dockage in the wheat to the elevators and sell the wheat without receiving anything for the dockage. Much valuable space is occupied in every wagon load of wheat, in every country elevator, in every carload of wheat, and in every terminal elevator and flour mill by the dockage in the wheat. If this dockage could have been removed at the time of threshing, the farmer would have been able to feed that part of the dockage having feed value, and he would also have saved the expense of hauling



The dockage problem not only is a serious one but one which steadily becomes worse

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28 and 29, 1921.

the dockage to the elevator. The farmer would in all probability have received a better price per bushel for his wheat if it had been clean, because among other things it is necessary in basing the prices which the country elevator pays for wheat to take into consideration either the cost of removing the dockage or the freight charges which must be paid on the dockage contained in the uncleaned wheat which is shipped to the terminal markets.

Dockage is always a troublesome factor in every stage of the marketing of wheat. It causes suspicion on the part of the farmer when he is selling his wheat because he has to depend upon the integrity and accuracy of the buyer when the percentage of dockage is being determined. Every time the grain is sold, one of the vital questions is, "How much dockage is to be assessed?" The only prevention of many of the disputes that arise during the marketing of wheat at the country elevator is either to raise wheat without dockage, or to take the dockage out of the wheat before the wheat is sold by the producer.

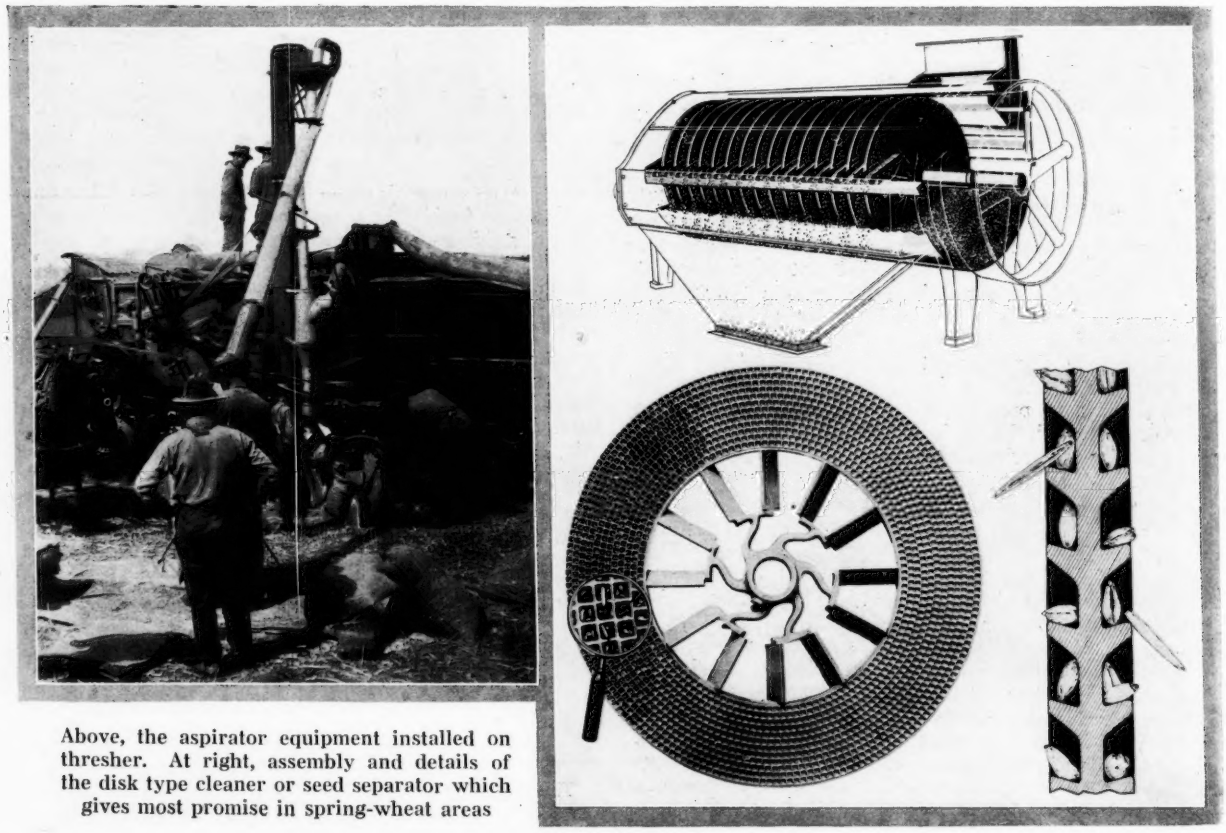
The federal grain investigations office of the United States Department of Agriculture on the Pacific coast had two experimental recleaners in operation on threshing machines during the 1920 season. One of these was an aspirator, and the other was a recleaner which is built for the export trade. The results secured during these trials indicated that it would be possible to develop apparatus which would make cleaning at the threshing machine entirely feasible, and it was decided to conduct similar tests in the spring wheat territory tributary to Minneapolis.

In the central northwest many weed seeds are common which are not found on the Pacific coast to any great extent. The seventeen seeds most commonly found in wheat grown in the central northwest are wild oats, wild buckwheat, tame oats, mustard, lambsquarters, barley, green foxtail, hares' ear, flax, rye, cow cockle, pigweed, yellow foxtail, sunflower, corn cockle, wild rose, and wild peas.

In past years before wild oats became so numerous, it was possible to remove such weed seeds as mustard and cockle from the wheat at the time of threshing by the simple means of placing a sieve in the bottom of the threshing separator, under the chaffer. This method is no longer effective because the wild oats which are present on nearly every farm in the central northwest quickly clog the sieves, sometimes to the extent of even stopping the flow of wheat to the grain auger. It is impossible during threshing to remove many of the weed seeds by blowing them into the straw stack, because if sufficient wind is used to blow out the weed seeds, a large amount of wheat will also be blown into the stack. Any apparatus therefore for use in connection with the threshing machine which can successfully clean wheat containing wild oats must be able to remove not only the wild oats, but should also have sufficient capacity to clean the wheat as rapidly as it is threshed.

In planning our grain cleaning experiments to be conducted in the central northwest, it was decided to concentrate our efforts on the installation of two types of cleaners, namely an "aspirator" and a "disk machine."

An experimental aspirator similar to the aspirators which the federal grain investigations office was using on the Pacific coast was built and installed on a 20x34 Port Huron separator. The top of the aspirator was fastened to the hopper which is directly below the weigher on the elevator. A valve was built into the hopper under the weigher so that the grain could be made to flow steadily out of the hopper and onto a metal disk 13 inches in diameter. The grain piles up on this disk and then falls steadily over the edge of the disk in a thin stream. As the grain falls over the edge of this disk, it is treated with a current of air which sucks out many



Above, the aspirator equipment installed on thresher. At right, assembly and details of the disk type cleaner or seed separator which gives most promise in spring-wheat areas

of the smaller and lighter weight particles which are deposited into a settling chamber, and the cleaned grain passes out through a spout into the wagon. The suction is produced by an exhaust fan running 2500 r. p. m. and driven from the beater shaft. The total weight of the aspirator and exhaust fan is slightly over 160 pounds.

The aspirator was operated while threshing oats, rye and a mixture of oats and wheat usually known as succotash. In these experiments between one-third and one-half of the foul material or dockage was removed from each of the grains mentioned with a slight loss of small and shriveled kernels of grain.

Before deciding upon the other type of cleaner to use, several months were spent in reviewing the advantages and disadvantages of the different kinds of cleaning machines used in elevators and flour mills. It was thought that it might be possible to make changes in some type of cleaning machine already in use so as to adapt it for use on a threshing machine, but it was found that all of the machines used in mills and elevators were either too large, too heavy, or of too small capacity for use on a thresher. To assist us in these investigations, the officials of several of the threshing machine companies showed us thresher recleaners which they had built, but which would not successfully clean spring wheat.

Wild oats seemed to be the cause of the failure of most of the recleaners already built, and as wild oats are numerous and hard to remove, it was finally decided to build a machine using the basic principle of disks provided with small pockets, and moving vertically through the grain. The elevator and mill machines of this type which were in use were found to weigh from 1½ to 4 tons and the biggest problem was to reduce the weight of the machine to 1000 pounds or less. The machine of this type which we finally built weighed only 670 pounds. The disks in the machine were made of aluminum. Both sides of these disks contain small undercut pockets and when set up the disks are mounted 2¾ inches apart on a shaft which rotates at about 60 r. p. m. The center of each disk contains fan blades for removing the grain toward the discharge end of the cleaner. The pockets on the disks being slightly undercut, pick up material of certain length and discard material of greater length, and as the disks rotate vertically the material picked up by the pockets is carried up and over the top of the rotating shaft and there discharged into small troughs. Three sizes of pockets were used for making the different separations, one size of pocket only being used in any one disk. The grain to be cleaned is fed into the machine near one end and the small weed seeds and dirt are picked out of the mixture by the first disk containing the smaller sized pockets, and as the grain progresses through the machine the disks containing the larger size pockets pick out the wheat kernels and leave the oats, wild oats, barley, and other material longer than wheat, which material is discharged through the opposite end of the machine. In operation the fine seeds are discharged into sacks at one side of the separator, the cleaned wheat is discharged directly into the wagons or tanks, and the wild oats and other coarse material which is discharged at the opposite side of the thresher may be either sacked or discharged directly into a second wagon.

The disk machine was installed on a 22-inch Twin City separator which was operated in North Dakota, and was used while threshing 8,000 bushels of Marquis wheat, 3,000 bushels of Kubanka durum wheat, and for separating 2,000 bushels of wheat from a mixture of wheat, oats and barley.

In our experiments the cleaner was driven from the fan shaft and only a little over one horsepower was required to operate it.

One of the objections made to the recleaners previously built for use on threshing machines was their lack of capacity, compelling the thresher operators to slow down the feeding when working in grain easily threshed. While operating our disk machine several attempts were made to clog or flood the machine, but it was impossible to feed the grain into the threshing cylinder fast enough either to clog the cleaner or to lower the quality of work which it performed.

The grain as threshed contained varying percentages of dockage, ranging all the way from 1 to 38 per cent. The efficiency of the recleaner was such that wheat which contained up to 20 per cent of dockage, after cleaning contained no assessable dockage. That is, the dockage remaining in the clean wheat was less than 1 per cent. When cleaning wheat containing over 20 per cent of dockage, it was necessary to make slight adjustments on the cleaner, but with these adjustments the dockage was reduced to less than 1 per cent in the cleaned wheat. The screenings removed in the cleaning operations contained very little wheat, in fact, much less wheat was found in the screenings from the disk cleaner than is found in the average elevator screenings.

It is our plan to make certain improvements on the disk recleaner and to continue these investigations through the next threshing season because the results secured the past season in threshing and cleaning over 15,000 bushels of grain demonstrated that grain can be cleaned successfully at the time of threshing to a point where no dockage will be assessed when the wheat is sold on the market. If wheat is cleaned at the threshing machine, farmers would not be paid lower prices or charged discounts because of the dockage which would otherwise be in it, nor would there be opportunity for disputes as to the percentage of dockage which should be assessed. The valuable parts of the screenings can be used for feed, and clean seed wheat will be available for sowing, which will mean increased yield per acre.

The Department of Agriculture is keenly interested from an economic standpoint in developing practical methods which will bring about both the sowing of clean seed wheat and the marketing of wheat free from dockage. These experiments have demonstrated that wheat can be successfully cleaned at the time of threshing and in the development of this method, the agricultural engineers, the threshing machine manufacturers, and the thresher operators can assist very materially in ridding the spring wheat states of the dockage problem.

DISCUSSION

MR. BARTHOLOMEW: I would like to know why it is necessary, or even the practice, in this wild oats country to raise wild oats at all. Why not just get rid of them before you ever raise crops? What is the use of raising them and then going to all this expense and trouble of getting them out of the grain after you have raised them? My theory is at least, backed up by some encouragement from practical farmers, that wild oats can be eliminated from the land by summer fallowing, that is, by plowing at the right time, in June, and it will take a long while for them to come back.

I would like to know whether there is anything in that. The same way with weeds. The best way to get rid of weeds is to kill them before they get into the crop.

MR. BLACK: Wild oats cannot be killed by one year's summer fallowing; that has been demonstrated time and again. The region of North Dakota and some parts of the Red River Valley of Minnesota are somewhat dry and the oats will not sprout unless they are near the surface of the ground where they receive the slight rainfall which occurs. Wild oats have been known to lie in the ground as long as 16 to 20 years, without their germination being entirely killed.

MR. WIGGINS: I would like to ask Mr. Black if it was his idea to equip all the present threshing machines with the device for removing dockage which he described?

MR. BLACK: The dockage question is increasing in seriousness, not only in the states that we are talking about, but all through the winter wheat states. The average dockage in the wheat marketed from Kansas this last year was slightly over two per cent. That may not seem like a large amount of dockage until you think of the large wheat crop which a state like Kansas produces. It runs into a large amount of economic waste in handling this dockage. Our idea hasn't been to manufacture or produce machinery that will be put on all the threshing machines, but rather to show that it can be done, and to create among threshing machine manufacturers an interest in the removing of the dockage. That is, the dockage question is a much larger question than is commonly supposed, and one which is increasing very rapidly, that is, the amount of dockage and the per cent of dockage is increasing very rapidly from year to year. I say very rapidly because an increase of even one per cent in three or four years means the amount of dockage produced is, you might say, a calamity.

MR. KRANICH: I would like to ask if anything can be done to urge farmers to clean their grain with so-called Bandey graders, or grain cleaners? If the farmer receives clean grain, and much should be done to urge him to do that, which would be a cheaper way, perhaps, than putting this device on the threshing machine?

MR. BLACK: I cannot answer that question from an impartial standpoint. I think that probably some of the men from the state agricultural experiment stations here really ought to answer that, because in their extension work they are really responsible for getting that information before the farmers. I don't think that anywhere near the amount of education has been brought to the farmers regarding the use of fanning mills or the advantages of using them in cleaning their seed wheat. I think there is a field for education there that shouldn't be overlooked by the agricultural experiment stations.

MR. WELTY: I would like to ask Mr. Black the question why the dockage seems to be increasing. On his chart for 1900 or 1905 there was only about two per cent or less of dockage, while in 1920 there was five per cent. Is that because there are more weeds allowed to grow, or is it because the wheat is getting more impregnated? Certainly the methods of cleaning today are as good as they were in those days, in fact, they are better.

MR. BLACK: The figures as to the percentage of dockage are not influenced at all by the buyer. The figures were established, and the dockages were assessed by inspection departments entirely separate from any buyers or actual handlers of wheat. That is at the present time and for the last four years, the dockage has been assessed under the supervision of the federal government, and the figures therefore are truly representative of the actual increase in the amount of dockage that is in the wheat when it is marketed.

MR. DICKERSON: In regard to this matter of the farmer cleaning the seed wheat, I had an interesting experience when I was teaching at the University of Illinois. We tried to put on a seed cleaning demonstration there once or twice and to get the farmers interested, and we also taught the work to the students in the regular agricultural courses, and it is really appalling the ignorance that the average farmer has of the proper use of seed cleaning machinery and the indifference they apparently have toward that part of farm work, and I am losing all hope of ever doing anything serious along that line. We have tried through the farm papers to encourage the farmers to clean their seed wheat, but I believe there are fewer fanning mills sold now in comparison with the number of farmers than there ever has been. Every grade of grain is a problem in itself. Every difference in size of kernel and every difference in the mixture of weed seed makes a different problem, and it is almost impossible to do anything very satisfactory in educating the farmer to use the fanning mill properly.

MR. DINSMORE: As a matter of fact, will fanning mills take the wild oats out satisfactorily?

MR. BLACK: The ordinary fanning mill, if properly operated, will take most of the wild oats out, and supposing that you had about 14 per cent of wild oats to start with, with the ordinary wheat that is raised in the Red River Valley of the North, you would probably be able to get out all of the wild oats except about one per cent.

The ordinary fanning mills will not remove the wild oats because the wild oats are of such a shape that they will go through the sieves. That is one reason we didn't attempt to use the sieves in our threshing machine experiments.

MR. DINSMORE: That in itself justifies the necessity of developing this cleaner on threshers.

DISCUSSION BY PROF. WM. BOSS

Mr. Black has presented a very interesting paper and I can see no reason why the machine would not be practical. I believe that by the use of such a device it would be possible to remove practically all of the dockage from wheat and to remove weeds and other small seeds from other grains.

I believe it would also be of considerable value in separating the various grains in such a crop as succotash, a crop which is being raised quite extensively in many communities, and which would be more extensively grown were it easily possible to separate the various kinds of grain of which it is composed.

I have discussed the question of weed seeds with Prof. C. P. Bull, Minnesota state weed inspector, who says that the weed problem is a serious one and a device such as this, that will remove the weed seeds, would be very desirable and would do much to eradicate the weed nuisance.

The important question, however, is the economic one. Whether the additional cost of equipping threshing machines with the device, the additional cost of power for driving it, the extra time required by the operator in looking after it, caring for the three separate deliveries of grain, etc. and the higher price per bushel which the farmer must pay for threshing, will be justified by the farmer receiving clean grain. At first thought, it perhaps seems doubtful. The average thresher would prefer not to bother with it and if the trend is to continue toward the small threshing machine operated by the farmer owner, it would probably not come into very extensive use. If, however, the trend is to be back to the commercial or professional thresher, and the thresher is competent and takes the proper pride in doing good work, I believe it would be a commercial success and would help to reduce the quantity of weed seed and wild oats sown, thus reducing the amount of dockage grown.

The weed seeds would have some feeding value to the farmer if ground or cooked. It would not be advisable to feed them unless so treated.

While the machine is especially designed for removing the dockage from the spring wheat grown in the north central states of the United States, it is possible that it would be desirable in other localities and perhaps be supplied on nearly all machines for threshing grain.

On the whole I believe Mr. Black's work is well worth while and I should like to see his experiments continued another year at least, working to perfect the machine and reduce its cost if possible, also continuing his cooperation with the various threshing machine manufacturers and see if it is not possible to incorporate the device as an integral part of the separator instead of an attachment to it. This it seems to me might reduce the manufacturing and sales cost and make its general adoption possible.

The Efficient Use of Animal Power*

By **Wayne Dinsmore**
Mem. A.S.A.E. Secretary, Horse Association of America

EFFICIENT use of animal power is the very basis of our system of agriculture. It has made possible the production of more farm products, per capita employed in agriculture, than in any other nation. The importance of the subject is shown by the fact that the studies of the Horse Association of America indicate that there were more than seventeen million horses and mules actually employed in work on farms in 1921. The only available figures on mechanical motive power use on farms is that disclosed by the census of January 1, 1920, which reported 246,139 tractors and 139,169 trucks used on farms. Mechanical motive power used on farms has decreased rather than increased since that time. It is therefore evident that animal motive power furnishes more than ninety-five per cent of the power used in field work on American farms.

You are agricultural engineers. Most of you are employed by the various states. The farmers of these states pay the bulk of the taxes which support your work. You owe them the direct duty of increasing, in every possible way, the efficiency of the motive power used on their farms, and this duty should take precedence over work designed to bring out and popularize new motive power. Motive power is power, whether it be animal motive power or mechanical motive power. From the broad scientific standpoint it is just as much your duty to study efficient ways of using animal motive power and methods of increasing the efficiency of such animal motive power units as it is to study efficient ways of using mechanical motive power or ways of increasing the efficiency of such mechanical motive power units.

Despite this obvious fact, I regret to say that practically no work of any kind has been done by the agricultural engineering departments of the various states relating to the more efficient use of animal motive power or relating to the development of more efficient types thereof, and I make this statement with full knowledge for on June 10, 1921, I sent letters to every agricultural engineering department in this country asking for complete, detailed information in regard to what had been done on this subject. Some scattered observations had been made here and there, but nothing of consequence had been done nor were there any projects at that time actually under way. I regret that I am obliged to make this statement, but it is the truth, and I hope that the publication of my statement in this particular, may arouse some of the agricultural engineering departments of the various states to the fact that they should do some definite constructive work along these lines.

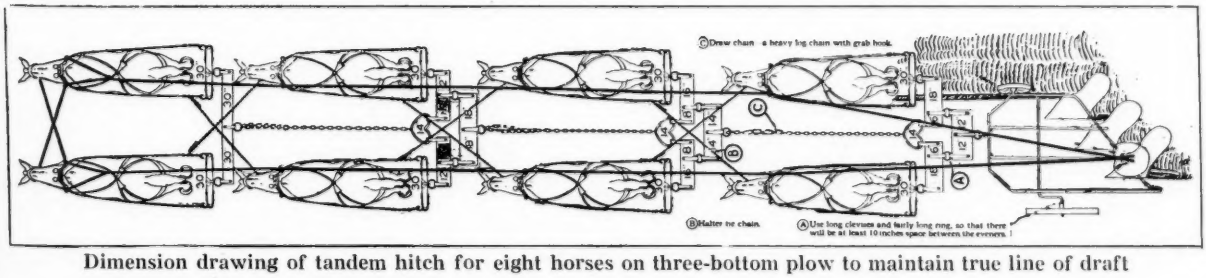
Work done by your retiring president, E. A. White, while connected with the Illinois agricultural college at Urbana brought out the fact that it is impossible to hitch three or more horses abreast on plows without some loss of power due to side draft. Close observation also disclosed the fact that the horses were working at a disadvantage because crowded together and not situated so as to obtain a straight, forward pull. These tests also demonstrated that it is possible to eliminate side draft by using plow hitches where teams were hitched in pairs tandem, also the fact that a correct angle of trace for teams removed some distance from the plow can be secured by weighting the clevis immediately back of such teams. The development of the pulley hitch, resulting from Prof. White's work, marked a step in advance; but these were altogether too complicated for the average farmer to build and while a company has put them on the market sales have been comparatively limited. Farmers do not want to use hitches that they have to buy. They want simple home-made hitches which will enable them to use their teams efficiently and which they can make up on their own farms during time which would otherwise be unoccupied.

From 1910 till 1920 my work as secretary of the Percheron Society of America took me to all parts of the United States and Canada, and during the last two years my work in behalf of the Horse Association of America has required still more extended traveling. I have studied very closely, and with regard to detail, the hitches used with all types of farm implements and with teams of varying size, and I have been able to conduct such observations in practically all of our states and in the northwestern provinces of Canada. What I have to say to you regarding efficient use of animal motive power is therefore drawn from unusually extended observation, and I shall present to you information regarding those hitches which have been tested out for years by practical farmers in actual field work and found to work satisfactorily with ordinary hired labor.

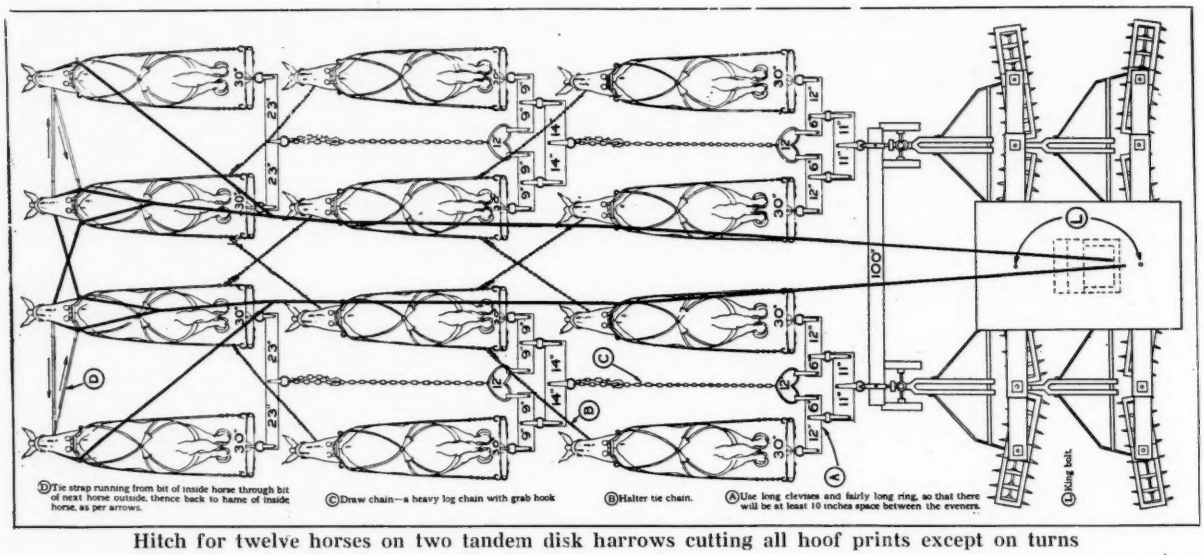
Three factors determine farm profits. These are the cost of production, the yield per acre, and the selling price. The selling price of most farm products is determined by world wide conditions which are beyond the control of any individual. The cost of production and the yield per acre, however, are partially within the control of each individual farmer. The type of farm power used and efficiency shown in its application have more to do with reducing costs of production than any other factors.

As an illustration, take conditions observed in different parts of the United States and Canada. The amount of plowing done in a day by one man may serve for comparison. This ranges from one to one and a half acres in New England, from two to three acres on many farms in Pennsylvania and Ohio, from four to six acres in Illinois, Iowa and other midwest states, and from eight to twelve acres in our

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28, and 29, 1921.


C Draw chain a heavy log chain with grab hook.
B Halter tie chain.
A Use long clevises and fairly long ring, so that there will be at least 10 inches space between the evenes.

Dimension drawing of tandem hitch for eight horses on three-bottom plow to maintain true line of draft


30'
23'
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(D) Tie strap running from bit of inside horse through bit of next horse outside, thence back to hame of inside horse, as per arrows.
(C) Draw chain—a heavy log chain with grab hook
(B) Halter tie chain.
(A) Use long clevises and fairly long ring, so that there will be at least 10 inches space between the eveners.
(J) King bolt.

Hitch for twelve horses on two tandem disk harrows cutting all hoof prints except on turns

own western and northwestern states and in Canada. The amount of work done in other operations, such as disking, harrowing and seeding, varies in substantially the same proportions. It is obvious that the man labor expended per acre is much higher in New England, Pennsylvania and Ohio than in the Mississippi Valley, and that there it is higher than in the northwestern states and Canada. The cost of production is consequently greater. The size of fields, character of land and presence of stones or stumps make it impossible in many instances to apply the same labor-saving methods used in the West and Northwest to farms in other sections, but whenever and wherever these larger units can be used, production costs can be measurably reduced. It is now, and always has been true, that horse labor costs less than man labor in the United States; and if, by increasing the number of horses used, we can reduce the amount of man labor required, the advantage to farm profits immediately appears.

Surveys made by the Horse Association of America within the last two years show that the number of horses needed varies from one for each 20 acres to one for each 32 acres of tilled land. In general it may be said that well-managed farms, where good rotation of crops exists, can be operated with one horse for each 25 acres of tilled land. West of the Missouri River, where small grains are grown more generally, many farmers are efficiently operating large farms by using one horse or mule for each 30 acres of tilled ground. The exact number required will depend upon the size of the fields, rotation of crops and climatic conditions plus the degree of intelligence manifested by the individual farmer in handling his farm work.

The rule should be to have a little too much, rather than not enough power, even if it be necessary to buy an extra team in the spring and sell it off in the fall. The man labor saved and the more timely despatch of the various farm operations will more than offset any slight loss between buying and selling prices. If the individual be a competent judge of horses or mules, actual profit will result, for good type four year old horses or mules can be bought in the spring and sold at a profit in the fall.

The experience of farmers in the West, Northwest, and Canada furnishes ample evidence of successful use of large teams and the establishment of a standard day's work. It has been found possible to drive teams 20 miles per day in a ten hour day on various farm implements and to maintain this rate week after week. This allows two hours for driving to and from fields, hitching and unhitching, turning at ends and occasional examination of collars, etc. It requires that teams shall actually be in motion on productive work eight hours per day at an average speed of 2½ miles per hour. When fresh, horses will exceed this; when weary, they will not equal it, but it is a practical standard, attained where sufficient horses or mules are used to permit of steady driving, without stops to rest animals. Whenever teams require stops for rest, not enough power is being used. Put on another horse or a pair, or more if necessary, but add enough so that you can turn dirt 20 miles per day and not overdo the teams. The number of horses needed will depend on the hardness of the ground, the depth to which implements are cutting, the weather and the age, size and condition of the work animals used, so that each man must use horse sense and gauge his teams according to power needed.

Twenty miles productive work daily means 5.6 acres plowed with two bottom gangs, 14-inch plows; 24 acres double disked with 10 feet disks and trailer attachment; 70 acres harrowed with 6 section harrows (5 feet sections); and as these soil preparation tasks are the ones requiring the most time, they also offer the greatest opportunity for cutting costs by increasing work done per day.

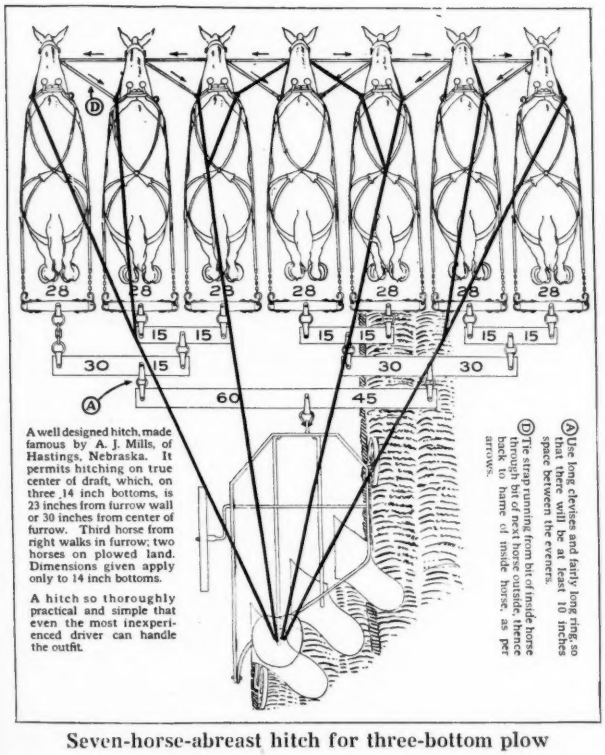
Disking is the greatest labor-saving soil tillage operation. On good farms it precedes and follows plowing. It pulverizes trash, kills weeds, conserves moisture and makes easier and better plowing. The 20-blade, 10 feet disks now available are usually drawn by six horses, but often need eight for steady progress, especially early in the spring when the horses are soft. One rule governs: Use horse sense, and if you see the load is too heavy for the number of horses you are using, put on more, until there is enough power attached to allow the horses to walk at a good pace all day. You hire men to accomplish work, not to sit out in the field waiting for horses to rest and recuperate, and it is sound economy to furnish plenty of power, especially as one more horse, or a pair, will turn the balance between overload and ample power.

Plowing is heavy work, made worse by the general practice of crowding the horses too closely together and by failure to hitch on the true center of draft. On every plow, whether one bottom or more, there is a point of hitch termed the "center of draft" and when the hitch is made at this point, the plow pulls with less exertion than when the hitch is made at a point more distant from the furrow. On a gang plow, two 14-inch bottoms, this center of draft is approximately 16 inches from furrow wall or 23 inches from the

center of furrow when plows are cutting full even furrows as they should. This means, therefore, that the eveners must be of such length, and the horses so hitched, as to give a straight forward pull over the true center of draft. This cannot be attained with four or more horses except by putting a horse or horses on plowed land, or by stringing the pairs out tandem fashion. If the hitch, for three or more horses, is made more to the left, so as to put the right-hand horse in the furrow and the others on solid ground, they pull the plows at great disadvantage, and the extra load thus created is called "side draft."

The average Illinois or Iowa farm is a six horse farm, i. e., there are usually 150 acres, more or less in crops, aside from pasture, woodland, orchard, yard, etc., and six horses of working age are kept. Every farmer should recognize that it is just as easy to drive four, five or six horses as it is to drive two, providing they are properly hitched; and the ease with which eight, ten and even sixteen horses are handled in the west by hired men who never before drove more than two or four, is evidence, if proof be needed, that there is no real obstacle to multiplying the amount of work done per man per day. The size of the units, however, must depend largely upon the size of the farm. On a one hundred acre farm, there are seldom more than 80 acres in tilled land, and four good horses are ample to operate such acreage. The implements purchased and the hitches used should therefore be based on a four horse unit. This calls for six-foot disks with trailers, (12-disk units), two bottom gang plows of 14-inch bottoms and 4-section harrows, together with seeders not over ten feet in length. Other implements should be proportionate. All these can be handled by four good horses, although if the ground is full of stones or ledges of rock, gang plows cannot be operated satisfactorily. Under such conditions, it is wise to use 14 or 16-inch walking plows with three horses, which are the oldest but most satisfactory plow units for use on such land.

On farms that have around 150 acres in tilled land, six good horses or mules will be needed. Here, with fields of 30 acres or over, six horse units can be used on disks, plows and harrows, which are the implements chiefly used in the preparation of the seedbed. It is in soil preparation that the greatest saving in man labor can be effected. One man, by using six horse units wherever possible, can handle all the work on a farm containing 150 acres of tilled land, until time for corn plowing, thus cutting down the need for an extra farm hand to the months of June, July and August, three months instead of six.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A well designed hitch, made famous by A. J. Mills, of Hastings, Nebraska. It permits hitching on true center of draft, which, on three 14 inch bottoms, is 23 inches from furrow wall or 30 inches from center of furrow. Third horse from right walks in furrow; two horses on plowed land. Dimensions given apply only to 14 inch bottoms.
A hitch so thoroughly practical and simple that even the most inexperienced driver can handle the outfit.
Ⓐ Use long clevises and fairly long ring, so that there will be at least 10 inches space between the eveners.
Ⓓ The strap running from bit of inside horse through bit of next horse outside, thence back to hame of inside horse, as per arrows.

Seven-horse-abreast hitch for three-bottom plow

On some farms throughout the corn belt and on a good many farms west of the Missouri River, the acreage under cultivation may run up to from 400 to 1000 acres per farm, and there are some places where the improved acreage runs up to 25,000 or 30,000 acres actually under the plow. On these larger farms the use of 7, 8, 9, 10, 12, and even 16 horse units on various farm implements is both practical and desirable, and I take pleasure in showing herewith efficient hitches long used by farmers with such larger teams. The seven-horse hitch shown in the accompanying illustration and the nine-horse hitch, based on exactly the same principle, have been brought into prominence by A. J. Mills, of Hastings, Nebraska, although I found similar units in use on various farms in Canada, the owners of which had no knowledge of the work which Mills had done in developing these larger team units. The great advantage about this seven-abreast or nine-abreast hitch is that it gives an absolutely straight pull over the true center of draft and the horses are back next the plow and are so hitched and driven as to make it possible for anyone to handle the team very easily. The only disadvantage that can be charged against the hitches in question is the fact that they require three or four of the horses to walk on the plowed land, but the objection to working some horses on the plowed land, although generally made by the average farmer, is inconsistent, for the very men who object to working two, three or four horses on fresh plowed land will work five or six of them abreast on the same freshly plowed land the same day or the next while harrowing or disking, and the actual experience of men who have worked these seven, eight or nine horses abreast on plows shows conclusively that this objection has no serious weight. The strongest, toughest horses, best able to withstand the work, should be put on the plowed land and they will keep pace with the others so that no slackening in mileage per day will result. The details of these hitches are so fully shown in the illustrations that I do not need to enter into detailed description at this point.

Three bottom gang plows (14-inch bottoms) will turn 8.4 acres per day; four bottom gang plows (14-inch bottoms) will turn 11.3 acres per day; two 8-feet disks hitched abreast with trailer attachments (double disking a strip 16 feet wide) will double disk 38 acres per day; an eight section harrow (5-feet sections) lapping one foot each round, will harrow 94 acres per day, and the three seeders (one 12 foot and two 11 foot) will seed 80 acres per day.

While the majority of men prefer an abreast hitch, because of greater ease in handling horses and keeping each animal up to his share of work, others who have more skillful teamsters available prefer the tandem hitch, where pairs are strung out as shown. This unit, found in successful use on many farms in the northwest and in Canada, is easily made up on any farm, but it is important that the units should be made up exactly as shown, and the heart-shaped ring, made from $\frac{5}{8}$-inch round iron rod, should follow the diagram both as to shape and dimension shown in the center. The distance between the eveners, adjusted by the length of the log chain, should be no more than just enough to permit the horses to walk without stepping over the evener in front of them. It will be found that they can touch noses to the tails of the horses ahead and still not interfere with the evener. At the turns, the eveners drag on the ground, but the horses soon learn to avoid them, as well as the draw chain and singletrees. The records of farms where these hitches have had

long usage, show that this is not a source of accident or injury for the animals. Halter tie chains extend from halter to traces of horse diagonally ahead. Adjust length as needed to let horse work with free head.

It is very important that the traces on the swing and lead teams pull at right angles from their shoulders to the singletrees, the same as on the wheel pair. If, instead, they tend to run parallel with the horses' backs, the teams work at great disadvantage and in many instances sore shoulders result. The condition when encountered can be remedied by attaching a weight to the evener or to the chain just in back of the evener, sufficient to bring the traces of the lead and swing pairs to a right angle with the shoulders, as observed on the wheel pair. Also, if any horse seems persistently inclined to forge ahead tie a strap from the check rein back to the heart-shaped ring, making the length such that he will be pulled back whenever he tries to advance too much. This is called "bucking back," but will seldom be needed if the draw chains are adjusted so as to bring the eveners back close to the horses' front feet.

All eveners shown that have to withstand the full pull of eight or more horses, should be of 2x10 or 2x12 material. The larger size should be used if evener is long, as in the 8 or 9 abreast plow hitches. The short eveners in tandem hitches that withstand pull of four or six horses should be 2x8, and the smaller eveners can safely be made from 2x6 material. The eveners should all be made of the best hickory. Where this cannot be obtained, other materials, such as oak or ash, are sometimes used but are liable to give way under heavy pull. Hickory alone can be depended upon to stand the strain.

Where the ground is unusually dry or horses small, it is oftentimes desirable to put on one more team on a three-bottom plow and turn an eight-horse tandem hitch into a ten-horse tandem. In such cases, it is customary to use the slowest team next the plow and to hitch them directly to the plow while a chain runs from the plow clevis forward to the first team ahead of the wheelers. These and the teams ahead of them are then hitched on the regular eight-horse tandem, as shown in accompanying illustration, and in actual practise farmers report that it is better to do this than to undertake to make up the same type of tandem hitch involving ten horses.

Disking land pulverizes trash, kills weeds, conserves moisture, makes plowing easier and is one of the most effective of all tillage operations. Anyone can drive four or six horses on an ordinary disk with trailer attachment. It is just as easy to drive 12 horses on two disks with trailers. The accompanying illustration shows how to unite two double disks for use with the 12 horse team. The hitches are simplicity itself, as they only consist of two six horse tandem hitches.

It may be argued that it is impossible for one man to take these large teams to and from the field and to hitch and unhitch them alone. That this is erroneous is shown by the fact men who have never driven more than four quickly learn how to take 12 horses to the field, hitch, drive and unhitch without assistance. On the Noble farms, where these 12 horse teams have been in use for several years, teamsters are paid a bonus of 50 cents a day for each pair used in excess of four pairs. One man receiving a bonus of one dollar per day accomplishes as much as two men under the old system. The saving is obvious.

In taking such teams to the field, the off horse in each pair is tied to the hame of the near horse, and the near horse has his tie chain fastened to the left side of the horse immediately ahead, at the point where the back band crosses the traces. The three pairs on the right are thus attached tandem fashion, just as they work in the field. The three pairs on the left are hitched together in the same way and the driver can either lead his teams to the field four abreast, or, if the road is narrow, the lead pair in the left six can be dropped back of the wheel pair in the right six. On arriving at the field, the left six is untied and led up beside the right six. The horses are then led directly into their respective positions. The four lead horses are then hitched. The first step is to snap the lines into the bits, then run them back through the hame rings on the swing and wheel horses, tying lines to the seat. Traces of the lead four are now hitched and tie straps of the swing four attached thereto. Traces of the swing four are then hitched and tie straps of the wheel four attached thereto. Traces of the wheel four are next hitched and driver swings to his seat and drives off. In unhitching, reverse steps just described.

Eight horses from this outfit can be used wherever needed by dropping out the wheel four with their eveners and draw chains. The sixteen-mule team used on three seeders is handled in same fashion as the 12 horse hitch. An eight abreast plow hitch can be made by taking the eight horse hitch off harrow, and putting in another evener (instead of the 20-foot harrow evener) of correct length to strike the "true center of draft," next to the plow.

In conclusion I wish to say that what I have presented here is but a beginning in the study of more efficient use of animal motive power. One large farm that is making extensive use of 12 and 16 horse units will carry out some further experiments this coming season by doing away with unhitching at the noon hour. It is planned to water and feed the horses in the field from feed bags without unhitching, and the plan which is to be put into operation is based on the experience of the British army during the late war. If actual field work proves the plan to be successful it will be another distinct contribution to the efficient use of animal motive power for it will save time and increase the amount of work done per day.

DISCUSSION

MR. CLYDE: On those smaller hitches in which we are more interested I am wondering just what the advantage of putting some of the horses on the plowed ground is, to get rid of side draft of course, but you are working the horses on plowed ground much harder, and I wondered if there is much advantage in doing that; one would offset the other.

MR. DINSMORE: You are getting rid of side draft and making it possible for the horses to pull straight forward. You do away with sore shoulders, and while you are working the horses on the plowed ground somewhat harder, you can obviate or overcome that by putting your strongest horses out there so you actually get more work done per day. Put on enough power to drive your 20 miles per day, and while weather conditions, soil conditions, depth of plowing, conditions of your horses and all must govern, the one test is this; do you actually turn dirt 20 miles a day, are you driving your horses constantly, or must you stop to rest them? If you have to stop to rest them, it is proof positive that you are not using enough power and our great trouble with ninety-nine farmers out of one hundred is that they are not using enough power on the heavy work, such as disking and plowing, and if you men will simply go to them and impress on them that the one test is to put on enough power so they can drive straight through, you will do more than any other one thing. Of course I know absolutely that a great many farmers object very strenuously to putting any horses on the plowed ground. You cannot do anything with those fellows.

QUESTION: Have you made any observations as to the real speed you get in going down the furrow?

MR. DINSMORE: Yes, I have actually timed teams over measured distances with stop watches. A good big team, fresh, will walk close to three miles an hour. When they begin to get tired they will drop down to even 2 miles. If you overload them they will go less than that. On the average I

would say they will walk a little better than 2½ miles when fresh and gradually taper down to about 2 when they begin to get tired.

Report of the Committee on Animal Motors

I. The most important, because most costly, single factor in farm crop production is motive power.

II. Animal motive power constitutes more than 90 per cent of all power used in field work at the present time.

III. No accurate scientific work has ever been done in America to determine the efficiency of animal motive power units.

IV. Definite, accurate data regarding the efficiency of animal power will contribute immeasurably to the production of more efficient animal motive power units.

The Committee on Animal Motors of the American Society of Agricultural Engineers accordingly recommends that work be begun at the earliest possible moment by the federal department of agriculture and state agricultural experiment stations to determine the absolute pulling power of horses and mules (which relates to their efficiency as animal motors) to be determined in the following specific projects recommended by this committee:

1. Determine maximum pulling power of horses and mules for short periods, alternated with periods of rest.

2. Determine maximum pulling power for 10 days, also for period of 20 days.

3. Determine maximum pulling power of horses and mules for a day's work of 10 hours.

4. Determine maximum pulling power of horses and mules for a ten day period, wherein animals are worked for 5 hours per day, 2½ hours in forenoon and 2½ hours in afternoon.

An accurate record shall be kept on the following controlling factors to be observed:

1. Feed consumed. Time fed, kinds and amounts given, physical condition of feed and exact analysis of feed used, different rations to be used to test efficiency of rations on efficiency of horses.

2. Determine from foregoing and work accomplished the thermal efficiency of animal motive power units.

3. Temperature, humidity, wind, cloudy or clear, and any other meteorological factors.

4. Kind of harness and manner of hitching.

5. Length of pulling period and period of pause and rest.

6. Weight, height, length, grip on road surface, muscular development, angle of shoulders, age and sex, special attention to be given to testing various types of horses, good, as well as defective or unsound types to be studied. All of these factors are of far reaching importance as a guide to breeding operations.

7. Temperature, respiration and pulse of horse in tests.

It is further recommended that a thoroughly experienced competent teamster be employed and that he shall train and condition all horses for at least 60 days before they are put into any tests to insure horses being in normal condition.

These tests shall, at the outset, be conducted under controlled conditions which shall be set forth in the report, and subsequently under normal field conditions.

These tests shall be conducted under the immediate personal supervision of a committee consisting of an agricultural engineer, a trained horseman, a nutrition specialist, a veterinarian, and an experienced farmer.

This is but the first step in a program of animal power studies intended to ultimately determine the efficiency and economy of animal power.

Discussion on Plow Hitch

Editor's Note: This discussion followed the presentation of the paper, "Coordination of Theory and Practice in Plow Design and Operation," by A. C. Lindgren and O. B. Zimmerman at the fifteenth annual meeting of the American Society of Agricultural Engineers held at Chicago, December 27, 28, and 29, 1921. The paper was published in the January number of Agricultural Engineering.

Mr. Clyde: One phase of this I have become interested in, because I attempted to do extension work on this matter of plow hitch, and I found, of course, that there were some difficulties, that is, in the matter of the vertical hitch. I have had occasion to measure and draw up several tractor plows to see whether it were possible to hitch in the straight line of draft vertically, and I find several plows on the market now where that is impossible. With the lowest hitch you can get you are below the straight line of draft, and naturally you are putting more weight on the front wheels and less on the rear wheels.

I wonder if there isn't some justification for that. The rear wheel is usually small, and therefore it is not as well fixed to carry the weight as the two front wheels which are the larger. I wonder if it wouldn't be possible to design the front wheels so as to carry practically all the load, making them large so as to reduce the friction and take practically all the weight off the rear furrow wheel.

Mr. Lindgren: Your troubles there depend largely upon the height of the hitch on the tractor. It may be that the hitch on the plow is not low enough to meet the height of hitch you had on the tractor, which was lower than usual.

Mr. Clyde: That is absolutely the case. I am thinking particularly of the Samson tractor and the plow where the tractor hitch is very low.

Mr. Lindgren: There are some tractors out where it is almost impossible to hitch a plow and distribute the weight evenly on all three wheels. In regard to your question of having all the weight on the front wheels, I don't think it is good. The aim is to hold the back end of the plow down, because it is the first end of the plow that comes up when it gets full, and anyone can tell you, after operating dull shares, that it is the back end that rears up first. In many conditions the shares don't keep sharp very long either. A plow when properly operated should have the weight evenly distributed on the three wheels.

One good way of telling is to run alongside of the plow and grab hold of the wheel and feel what it takes to stop it, and then grab one of the front ones and then govern your hitch accordingly.

Mr. Collins: I would like to ask more specifically about the matter of the sharpness of the share. It has been my experience that unless we are working in alfalfa or something like that that has roots, that the sharpness of the edge has very little if any effect, but the form of the plow is what makes the difference; as he said, the way it fits on the bottom. If it is not up on the bottom you have the dragging effect. The experiments that I have run in that line I merely took a new share and dulled the edge so there was an eighth of an inch edge on it all the way along, but the plow was still, you might say, in ideal form. I found that in ordinary plowing it didn't show any difference.

Mr. Dickerson: I didn't quite understand Mr. Zimmerman's statement that the coefficient of friction was 1 in the case of the dull share.

Mr. Zimmerman: The coefficient of friction varies in different soils, whether you have a sandy or loose soil. It varies all the way, according to very meager experiments, from 0.3 up to 1, and with certain very unusual soils up to 1.2. In other words, the coefficient of friction was greater than 1, considerably.

The College Section and Its Possibilities*

By J. B. Davidson
Mem. (Charter) A.S.A.E. Professor of Agricultural Engineering, Iowa State College

IT HAS been pointed out that the stability, the success, and the future of any organization depends upon having in its individual membership a common interest and a clearly defined purpose. Stated inversely it is impossible to build a strong, efficient organization out of a membership with diverse interests and the wise never attempt to do so. Organization and association effort is carried forward and developed by a magnification of the common interest and a depreciation of the conflicting interests.

If this principle of organization be true, then the newly organized College Section of the American Society of Agricultural Engineers is based on a solid foundation, for as far as I am able to see the interests of the membership of the College Section are absolutely common. If there are any conflicting interests I do not know them. The agricultural engineering departments of the agricultural colleges and experiment stations are all trying to render the same kind of service and differences exist only as they relate to the needs of local communities.

The College Section is one of the most promising developments in the history of the American Society of Agricultural Engineers. It is comprehensive—it plans to include all of the public institutions, federal and state, committed with education and research in agricultural engineering. It has been pointed out that much effort has been lost and the general efficiency of educational work in many lines has been lowered through lack of cooperation.

The new College Section is planned to be an outstanding example of cooperative effort. It bids fair to attain such recognition because it is being organized at a strategic time with the full support of all parties concerned.

No doubt most of those present are familiar with the steps which led up to the organization of the College Section. In October 1920 an invitation to a number of college representatives from the different geographical sections of the country was extended by the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture to come to Washington to discuss the general problem of cooperation. Those in attendance at this conference became much enthused over the possibilities of cooperation and the provisions written into our revised constitution for a College Section came from plans made at this conference and which were reported to the Society at its last annual meeting by S. H. McCrory of the United States Department of Agriculture.

The significant features of the organization of the College Section are as follows:

1. The necessity of an entirely new organization is obviated.

2. Membership is not limited to members of the Society thus making membership in the Society more inclusive.

3. Each state is entitled to one vote and only one vote in business matters thus providing wide representation.

4. The officers consist of (a) a chairman appointed by the President of the Society; (b) secretary who shall be the Secretary of the Society; and (c) an advisory committee of five members of which the chairman is one.

The first conference undertook to make a general survey of the agricultural engineering field and outline a plan of action. A statement was made of the relation of agricultural engineering to agricultural development. To this conference the functions of agricultural engineering—which would constitute a grouping of the many phases of civil, mechanical, electrical engineering and architecture applied to agriculture, are as follows:

1. To bring about an improvement of living conditions on the farm by the general betterment of dwellings and the introduction of modern time and labor-saving devices.

2. The increasing of the efficiency of the individual farmer to the end that his earning capacity may be increased, and funds be provided for maintaining the desired standard of home life.

3. The enlargement of the productive area of the country by the clearing of stump lands, the drainage of wet areas and the irrigation of arid regions.

At this conference cognizance was made of the commercial and professional society, state and federal departments, and various agencies now existing and interested in the furthering of the development of agricultural engineering practice and science. The relation of these were carefully considered. It was clearly pointed out that those agencies receiving public support had much in common and that for safeguarding the use of public funds should be grouped together.

Careful consideration of the situation developed enthusiasm to the idea that substantial progress in solving its agricultural engineering problems of the present and the future and efficiency in the dissemination of useful information now available, or to be obtained from future research and surveys, will depend to a large degree upon the cooperation of the various agencies in correlating their work.

It was recognized that the greater burden of the work must come upon the state agencies on account of greater resources. Although local problems should be studied by local organizations much could be accomplished by assigning parts of large general problems to certain institutions.

It was further pointed out in the report of this conference that the U. S. Department of Agriculture should take the lead in coordinating and stimulating the work of the state colleges and experiment stations, and other agencies on local or specific problems, in which special care should be taken to maintain individuality of organizations and workers. Furthermore, the United States Department of Agriculture should supplement the work of the states by its own surveys and investigations and conduct work which for any reason cannot adequately be performed by the state agricultural colleges or experiment stations.

At a conference held at Washington last May careful consideration was given to the development of research in agricultural engineering. It was evident from a study of the situation that (1) little research was being conducted regardless of the fact that such work is fundamental to good teaching and extension service, and (2) such research as was under way was not fundamental in character.

An accurate statement of the situation was given in an editorial in the August (1921) number of the Experiment Station Record and should be read by all.

At the May conference an outline of the research problems which in the minds of those in attendance needed attention was made and is available for all those interested. Some forty-five problems were listed.

It should be the function of the College Section to see

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28 and 29, 1921.

that work is begun on these problems at the earliest possible date. Every college man should select some problem and have his selection recorded with the proper committee.

The efficiency of experimental work and research at the present time is lowered materially because it is the common practice not to report any results until the work is completed. The outcome of this practice is that such work is never reported and therefore lost. Furthermore, it would be a material aid to have progress reports circulated among research workers before conclusions are drawn. Such data would include isolated observations from tests which would not be suitable for publication by itself. A committee has been appointed to arrange for the circulation of such data. It is obvious that certain restrictions must be introduced and the personal responsibility of those receiving the service fixed.

I would like to commend the most excellent work performed by our Research and Data Committee during the past year. It is a splendid service that this committee is rendering in criticizing the project outlines submitted. I would strongly urge that all new projects be submitted to the committee.

It appears to the speaker that sufficient care has not been taken to cultivate public opinion. We live in a democracy. We are permitted if not compelled to do that which the public wishes done. Engineering methods have had a far reaching influence upon agricultural development.

The capacity of the individual farm worker, the standard of farm life depends almost directly upon the application of agricultural-engineering methods to production and rural life. Likewise, future progress depends upon the development of agricultural engineering. Let us so educate the public.

Handling Quicksand in a Well

EDITOR AGRICULTURAL ENGINEERING:

IN ANSWER to the query of L. F. Beers in the December, 1921, number of AGRICULTURAL ENGINEERING, I wish to contribute the following:

As he probably knows, there are three general ways of combating quicksand through which a well or shaft is being driven. These are:

1. Casing the sand off entirely with steel, tile or other casing which should closely follow the bottom of the hole as it is driven through the sand. If necessary the casing may be cemented, thereby shutting off the water and sand more effectually. This method of course shuts the sand off entirely, and is useful only when it is desired to penetrate to deeper strata.

2. In sinking dug wells and shafts through quicksand it is becoming a modern practice to freeze the quicksand while working through it and casing it off. The freezing is accomplished by the use of liquid carbon dioxide, air, etc. For details of procedure see articles in recent mining engineering publications.

3. In many cases it is desired to obtain water from the quicksand itself or a sand immediately below it. Often the water is under but very little head even though in great volume. It is thus necessary to set the pump near the base of the water-bearing formation if an efficient delivery of water is to be obtained. It is, of course, impracticable if not impossible to keep an open hole through quicksand for any length of time so some method must be used that will keep the sand out but that will let the water in. Perforated and screened pipe is used for this purpose in holes of less than six inches diameter and is fairly satisfactory but for larger holes screen pipe becomes increasingly inefficient if used by itself.

Here in California where large volumes of water for irrigation are taken from quicksands and semi-quicksands the following method is in use. The rough hole is drilled at least a foot larger in diameter than the finished bore is to be and a light steel casing is carried entirely through the quicksand and landed so as to exclude completely the sand. Then the "production string" consisting of enough screen pipe of about 200 mesh to reach through the quicksand with the necessary length of blank pipe above it is set in the center of the outside casing. A spacing ring is generally attached to the bottom of the inner casing to keep it nearly concentric with the outer casing. Then the space between the casing is filled from the bottom up with one-inch gravel, finer gravel and sharp sand that will not pass through the screen. The sand should fill the upper half of the length of the space outside the screen pipe and should continue at least as far up around the blank pipe and sand of any kind may be used from there to the surface. The outer casing is then pulled. All of it may be removed but it is perhaps better to pull it up only far enough to clear the screen pipe and remove the projecting length. Just enough cement should be cast about it at the surface to prevent it from sinking back into the quicksand. If the quicksand has a heaving tendency enough cement must be placed around the blank inner casing to hold the sand down. In well work concrete as a general rule is not as satisfactory as neat cement. Sometimes two outer casings are used so as to permit a ring of coarse sand around the inner ring as given above but with little better results. It should be noted here that there should be from twenty to one hundred feet of open hole or blank pipe, as conditions may determine, below the screen pipe so as to provide a settling basin for the sand that may work through thereby eliminating many otherwise necessary clean-outs.

R. E. ALLEN

Los Angeles, California

EDITOR AGRICULTURAL ENGINEERING:

AN ITEM in the December issue of AGRICULTURAL ENGINEERING, relative to keeping quicksand out of a cased well, has come to my attention.

The writer has made quite a study of the problem and has gathered considerable data on it and so far as he has been able to learn the following is the most satisfactory method:

After the casing has been driven and the well cleaned out thoroughly it should be pumped daily for, say, two or three weeks to open the water veins and to clear as much quicksand as possible from the immediate vicinity of the well. After this has been done secure a large sponge, one that will fit the casing closely. (If a large sponge is not available two or three small ones wired together with copper wire will do.) Drop this in the casing and force it to the bottom; then throw in some rocks, say two to three inches in diameter, to hold the sponge down. This will clear the well of all traces of quicksand and does not seem to have any effect on the volume of water supply.

In a dug well a casing should be driven through the vein holding the quicksand and the above method followed.

C. T. MUDGE

Portland, Oregon

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Agricultural Engineering Investigation, Experimentation and Research

Edited by **R. W. Trullinger**
Mem. A.S.A.E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

STRENGTH OF BOLTS IN TIMBER, H. J. Finebaum, (*Engineering and Contracting*, Chicago, 56, 1921, No. 4, pp. 77, 78 fig. 5). Mathematical formulas giving working values for bolted joints are derived and a diagram giving the strength of bolts in timber is presented.

The diagram shows values for the theoretical bearing of bolts in inches, bolt diameters, bending strengths of bolts in timber, and unit compressive stresses in timber. The two following formulas for the working values of bolted joints are presented:

$$P = \frac{d^2}{4}\sqrt{15\,\pi\, f_s\, f_w}$$

$$L = \frac{d}{2}\sqrt{\frac{3\,\pi\, f_s}{5\, f_w}}$$

in which f_w = unit fibre stress in timber, f_s = unit fiber stress of steel in flexure, P = value of the bolt or the load on the bolt, t = thickness of the timber, d = diameter of the bolt, L = thickness of timber assumed as under compressive stress due to P, and M = bending moment on the bolt.

Where $L < t$, values of P hold; where $L > t$, values of bolt in bearing hold = $\frac{5}{8}\, dtf_w$.

STUDIES IN SOIL MOISTURE, I, B. H. Wilsdon, [India Department of Agriculture Memoirs Chemical Series, Thacker, Spink & Co., Calcutta, 6(1921) No. 3, pp. 155-186, pls. 5, Figs. 6.] This report is a preliminary account of the lines of work on the subject of soil moisture which have been developed by the Agricultural Research Institute at Pusa since 1917.

The importance of studying all the factors affecting the movement of water in the soil and particularly of the salts contained in irrigation water is pointed out. From an approximate calculation an estimate can be formed of the amount of water percolating from an irrigation area. Applying this to the irrigated fields of the Lower Chenab Canal colony it is estimated that the subsoil losses represent 38 per cent of the water taken in at the head works. The gross area commanded by the canal is 3,360,000 acres, and the total percolation is said to be in the neighborhood of 3,255 second-feet. Or the total loss 17.5 per cent is lost by absorption in the main line and branches, leaving about 20 per cent to be accounted for by loss from distributaries, water courses, and fields.

The average of a large number of analyses of irrigation water made at the station showed that the total content of soluble matter is about 12 parts per 100,000 and is composed almost entirely of the sulphate, chlorid, and carbonate of sodium. It is estimated that about 337,000 tons of sodium salts are added annually to the 2,258,000 acres of actually irrigated land in the colony, or from 0.1 to 0.2 tons per acre. The total amount of sodium salts percolating to the subsoil is estimated on the assumption that the subsoil water contains 20 parts of sodium salts per 100,000 and the irrigation water 10 parts.

On the basis of thermodynamical considerations, theoretical relations determining the equilibrium of a so-called free solution, having an osmotic pressure with the water bound in the colloid phase and the vapor phase, are deduced. From considerations of surface tension, a relation is deduced between the average size of soil particles and the film tension of water in the soil at various concentrations, by means of which it is possible to calculate the statical distribution of water in a column of soil saturated at its base. The relation of these deductions to the empirical soil constants is discussed and a satisfactory result is obtained for the calculation of the moisture-holding capacity of soils. Experimental results are given showing the variation of bound water in the colloid of a soil with the osmotic pressure of the solution. Extrapolation to zero osmotic pressure gives a value for the moisture absorbed by the colloid which is 4.7 times the hygroscopic coefficient. On the basis of these results an explanation of the empirical relationship between the moisture-holding capacity of a soil and its hygroscopic coefficient is afforded. It is suggested that the bound water of the soil exists in two phases which have been provisionally named "gel" water and vesicular water. A preliminary experimental investigation of the compressibility of soils is described, but the results so far obtained do not allow of any deductions being made as to the swelling pressure of the soil colloids, for which purpose it was intended. Experiments are described in which the hydrostatic pressure due to film tension is balanced against the osmotic pressure of a soil solution.

The following tentative conclusions bearing on the composition of the solution draining from soils and on the economic use of water are drawn: "In the case of a soil containing no colloid, such as a coarse sand, the behavior of the soil solution will be determined completely by the average size of the particles and the surface tension of the solution. The composition of the solution draining from such a soil should therefore remain unaltered. If, however, a saline water is added to a soil containing colloid, water will tend to move through the colloid phase in order to dilute the solution if its osmotic pressure is greater than the swelling pressure of the colloid, or the solution will become more concentrated if the reverse is the case." It thus appears that the first action is for free water to move across to the salt layer in order to dilute the solution, thus reducing the osmotic pressure and increasing the hydrostatic pressure on the water side. The salt then diffuses back carrying with it water. The final equilibrium will thus be obtained, in the absence of a semipermeable membrane, when the salt solution is equally distributed throughout, but the rate at which the salt solution will move back may be very slow.

"Since the equilibrium distribution of water in a soil is determined by the vapor pressure gradients in the soil atmosphere, the 'bound' water of the colloid will have a defin-

ite value at equilibrium at each point in the column; the concentration of the subsoil water will therefore affect the 'capillary' rise, whereas, in the case of a sand, it will only do so in virtue of its concomitant variations in surface tension. Since, therefore, the solution draining from a soil may be supposed to be in virtual osmotic equilibrium with the colloid at each point, the composition of the solution will be determined by the colloid content. We should expect therefore that the ground water beneath a heavy soil would be more saline than in the case of a light soil.

"Again, the rate of movement of a soil solution in a sandy soil should depend only on the gradient of hydrostatic pressure due to film tension and the viscosity of the solution. In the case of a soil containing colloids, however, we have two rates to consider—the rate of movement of water in the colloid phase and also the rate of movement of the free solution in virtue of its hydrostatic pressure.

"The importance of consideration such as these in determining the advisability of shallow and frequent or heavy and infrequent irrigations need not be emphasized. It would appear that in a light soil where the composition of the drainage water is unaffected, water economy should demand light and frequent waterings. In the case of a heavy soil, however, owing to the possibility of the concentration of the soluble matter of the irrigation water by virtue of a rate of diffusion of the water through the colloid phase to drier parts of the soil, greater than that of the free solution, the soil may become saline; heavy waterings, therefore, seem indicated. Moreover, although in such a soil, the water may penetrate beyond root range, it will still be available to some extent to the crop by upward movement through the colloid phase without carrying up salt."

MOTOR TRACTORS (Union of South Africa, Department of Agriculture Journal, Pretoria, 3, (1921) No. 1, pp. 46-60.] Tractor plowing trials conducted by the Transvaal University College are reported. The objects of the trials were to determine the efficiency of the tractors considered as plow tractors and to find the cost of plowing per acre for various types of soils and under conditions generally obtaining in the Transvaal. Each trial consisted of plowing 8 acres of virgin soil and 6 acres of old land and a brake test.

All plows were of the moldboard type. The tractors included wheel types, tracklayers, and motor plows. Thirteen machines competed and were of three classes as regards rating, nine being under 25 brake horsepower, three from 25 to 30 brake horsepower, and one over 30 brake horsepower. The majority of tractors were fitted with four-cylinder, four-stroke-cycle-vertical engines, with high-tension ignition and water-cooling systems of the types common in automobile practice. The type of automatic governor most in favor was the throttle governor. The oiling system for principal bearing surfaces was in all cases either force feed or a combination force and splash feed.

The soils consisted of light sandy virgin soil well overgrown with grass, sandy loam, heavy loam, heavy virgin grassland, stiff loam, and clay loam.

On the whole the plowing was of a very high standard. From the practical point of view, however, there was a marked difference in the work done which is attributed to inexperienced mechanics, difficulty in machine control, and unsuitable plows.

The tracklayer type of machine showed up to advantage in moving over soft ground, the large contact surface giving a better grip and causing less packing of the soil. This was especially noticeable in the cut-out where it was necessary to move over plowed land. The wheel tractors, however, moved over the soft soil quite effectively and had the advantage that there was less wear and tear on the wheels than on the tracks, and generally less power was absorbed by the former than by the latter. All the tracklayers moved with both tracks on the unplowed land, and the ease of the steering was not affected much by any side draft. In the case of wheel tractors improper hitching and with small tractors unavoidable side draft affected the control of the machine considerably. Where all four wheels moved on the unplowed ground the side draft tended to pull the front wheels into the open furrow and caused loss of power. A complete summary of results obtained is given in the accompanying table.

SUMMARY OF RESULTS OF TRANSVAAL PLOWING TRIALS

TRACTOR	Width of Cut In.	Depth In.	Crude Oil Gal.	Paraffin Oil Gal.	Petrol Pts.	Lub. Oil Pts.	Water Gal.	Net Time Hr.	Net Time Min.	Acreage	Cost Per Acre
LIGHT SANDY VIRGIN SOIL											
Class I											
OilPull	40	7.5	15	0.125	....	9.5	57.0	13	12	6.01	$2.11
Cletrac	25	5.75	...	7.375	4.0	4.0	1.0	5	00	2.95	3.47
E-B	36	6.0	...	15.25	24.0	4.0	6.0	9	49	5.89	3.65
Fordson	23	5.9	...	11.66	4.0	6.0	8.5	11	55	5.96	3.24
Glasgow	22	6.3	...	19.75	4.66	10.0	6.0	11	33	5.92	4.26
Samson	25	5.75	...	16.5	17.0	0.25	4.0	9	56	5.96	3.43
Titan	37	6.5	...	21.5	1.0	10.0	30.0	9	00	5.98	4.22
Class II											
Case 15-27	36	5.5	...	16.5	0.5	8.0	0.5	8	55	6.05	3.04
J-T	36	6.75	...	20.0	3.0	4.66	...	8	8	6.02	3.65
Peterbro	36	6.0	...	19.0	16.0	14.5	...	7	42	5.85	4.56
Class III											
Case 22-40	57	5.5	...	14.375	24.5	6.0	...	5	12	5.87	3.53
HEAVY VIRGIN SOIL											
Class I											
OilPull	40.5	7.5	8.5	1.5	....	4.33	28.0	4	52	2.07	3.20
Cletrac	No results										
E-B	36	5.75	...	8.0	4.0	2.0	2.0	4	16	1.99	4.85
Fordson	24	5.2	...	8.33	2.0	3.0	4.0	5	45	2.0	5.25
Glasgow	22	5.0	...	7.5	2.5	4.0	2.0	4	22	2.55	4.74
Samson	25	5.5	...	6.125	7.0	0.125	2.0	3	32	1.98	3.89
Titan	24	5.75	...	9.25	0.5	7.0	20.0	4	34	2.01	6.08
Class II											
Case 15-27	24	5.0	...	4.0	9.0	0.33	1.0	4	4	2.0	3.18
J-T	36	5.25	...	10.03	1.0	1.75	...	3	23	2.03	6.08
Peterbro	24	6.5	...	7.5	2.0	10.5	...	4	4	1.88	6.75
Class III											
Case 22-40	43	5.5	...	4.75	19.0	3.0	...	3	14	2.01	4.78
OLD LAND, MEDIUM TO CLAY LOAM											
Class I											
OilPull	67	7.5	8.5	0.125	....	5.5	36.0	6	4	4.09	1.70
Cletrac	25	7.5	...	8.65	7.0	8.0	2.0	8	26	4.03	3.57
E-B	36	7.0	...	15.75	15.0	4.0	4.0	7	28	4.06	4.87
Fordson	24	7.0	...	12.33	3.0	6.0	9.0	10	38	4.10	4.14
Glasgow	22	7.0	...	16.0	1.75	10.0	4.0	9	00	4.08	5.05
Samson	25	7.35	...	10.875	11.5	0.25	1.5	6	6	4.06	3.33
Titan	37	6.9	...	15.5	1.0	12.0	26.0	7	00	4.13	4.76
Class II											
Case 15-27	26	7.0	..	8.0	8.0	0.33	0.2	5	55	4.06	2.43
J-T	36	7.5	...	10.0	2.75	2.33	...	5	42	4.06	2.92
Peterbro	36	6.9	...	13.0	6.5	17.0	...	6	40	4.02	5.11
Class III											
Case	50	6.9	...	9.75	8.0	6.0	...	4	48	4.04	3.45
CLAY LOAM, OLD LAND											
OilPull	41	8.0	5.0	0.5	....	3.33	16.0	4	00	1.90	2.27
Titan	37	6.25	...	8.0	0.5	6.0	18.0	3	00	1.92	5.29

THE "BUCKEYE" OF THE DITCHER FOR LAND DRAINAGE —Trial in Cambridgeshire, H. V. Garner [Journal Ministry of Agriculture, London, 28 (1921), No. 4, pp. 306-320, pls. 2]. A series of tests with a tractor ditcher designed on the rotating bucket wheel system is described. The machine used was fitted with a twenty horsepower four-cylinder gasoline engine and a digging wheel capable of digging a trench 14.5 inches wide and 5.5 feet deep. The purpose was to determine the value of mechanical drainage trenching on English soils. The soils encountered were a stiff boulder clay containing a few large boulders and bands of chalk pebbles and in places uniform sticky clay. The work was conducted in bare fallow soil and on wheat stubble. The fuel used was benzol and second grade petrol.

It was found that the drainer could operate more rapidly at any given depth in a dry clay subsoil containing chalk and gravel than in a wet subsoil. The rate of excavation measured in chains per hour increased rapidly as the trench became shallow on the same type of soil. The cost of shallow drains was very much less that that of deep ones. Drains 3.5 feet deep in dry clay cost exactly three times as much to

dig as 2-foot drains in similar soil. The drainer was capable of excavating straight trenches to any depth not exceeding 4.5 feet. It was not successful in excavating trenches with a curve approximating a right angle. The trenches were excavated at varying speeds, according to the depth and moisture of the subsoil. Drains 3.5 feet deep in moist clay were dug at the rate of 1.7 chains per hour and in dry clay at the rate of 3 chains per hour. Drains 2 feet deep were dug in dry clay at the rate of 9 chains per hour.

In the experiment the costs of working were high owing to the conditions of operation. A conservative estimate of the cost of operation under commercial conditions is thought to compare favorably with present costs of hand digging. The trial showed that the friction produced by the revolution of the digging wheel in moist clay greatly retarded the speed of work and increased the cost. This friction was chiefly between the outside rims of the wheel and the sides of the trench. It is recommended that scrapers be fixed to the framework and adjusted to remove the adhering clay from the sides of the wheel to obviate friction.

It is further concluded that if the machine were fitted with a wheel and buckets capable of digging trenches a maximum of 11 inches and a minimum of 8 inches wide instead of respective maximum and minimum widths of 14.5 and 11.5 inches, considerable economy in operation costs might be expected. It was found that the consumption of fuel calculated from the daily figures of the whole trial averaged 2 1/3 gallons of benzol and 2/5 gallons of cylinder oil per running hour. The accompanying tables give the detailed results of the tests:

SUMMARY OF DAILY RESULTS

DATE	Hours Lost by Breakdowns	Hours Adjusting and repairing	Hours Working	Fuel Gals.	Oil gals.	Grease lbs.	Chains 3 ft. 6 in. Mains	Chains 2 ft. 6 in. Minors
19-8-20	1½	3	¾	2½	¾	½	1 1/5	.....
20-8-20	2½	1¼	3	8	1¾	...	6	.....
21-8-20	...	½	½	1½	...	...	½	.....
23-8-20	...	2	4	11	2	...	6 1/5	1
24-8-20	...	½	5¾	11¾	2	½	.....	14½
25-8-20	1½	1¾	6	11½	2¼	½	.....	21½
26-8-20	...	2¼	5	9½	1¼	¼	.....	19 1/5
27-8-20	...	2½	4¼	8½	2	5	.....	17 1/5
28-8-20	3	½	...	....	...	...	.....	.....
30-8-20	...	5¼	1	4¾	1¾	...	1¼	3
31-8-20	1½	1	3¼	7¼	¾	...	8¾	.....
1-9-20	...	2½	3¾	9	2½	¼	12½	.....
3-9-20	...	½	6¼	13½	2	...	6	36 1/3
4-9-20	...	½	¾	2	1¼	...	2¼	.....
6-9-20	...	¾	5¼	13½	1½	...	24*	.....
7-9-20	1	1	3¼	8½	1	1	4*	21½†
8-9-20	6	...	...	....	...	...	.....	.....
9-9-20	6	...	...	....	...	...	.....	.....

*Mains. 2 ft. 9 in. †Minors. 2 ft.

MACHINE PERFORMANCE AT VARIOUS DEPTHS IN DIFFERENT SOILS

TYPE OF EARTH EXCAVATED	Depth of Trench	Chains Trench Dug Per Gallon	Chains Trench Dug Per Hour	Gallons Per Hour	Tons of Earth Excavated Per Hour
Moist stiff clay	3 ft. 6 in.	.61	1.7	2.8	18
Moist stiff clay	2 ft. 6 in.	1.76	3.5	2.0	25
Dry clay with flints and chalk	3 ft. 6 in.	1.30	3.0	2.3	31
Dry clay with flints and chalk	2 ft. 9 in.	1.78	4.6	2.6	37
Dry clay with flints and chalk	2 ft. 9 in.	3.41	9.0	2.6	52

THE ADOBE MILK HOUSE, C. B. Brown, [Arizona Agricultural Experiment Station (Tucson), Circular 38(1921) pp. 4, Figs. 3.] Popular information is given on the construction of an adobe milk house, including specifications and diagrammatic illustrations.

THE WATER RESISTANCE OF TREATED CANVAS DURING CONTINUOUS EXPOSURE TO WEATHER, F. P. Veitch and T. D. Jarrell. [*Journal of Industrial and Engineering Chemistry*, New York, 13(1921), No. 8, pp. 672-676, Figs. 2.] Studies conducted by the U. S. Department of Agriculture as a part of the work on the waterproofing of cotton duck are reported, the purpose being to determine the actual relative water resistance in service of certain waterproofing preparations for treating cotton duck for outdoor use. In addition to exposure tests, laboratory tests were also made, both on the new, recently treated canvas and again after the canvas had been exposed for a year. The following eighteen treatments were tested: Amorphous mineral wax and beeswax; amorphous mineral wax, beeswax and lead oleate; amorphous mineral wax, beeswax, and copper oleate; amorphous mineral wax and paraffin; amorphous mineral wax, paraffin, and lead oleate; amorphous mineral wax, paraffin, and copper oleate; amorphous mineral wax and lead oleate; amorphous mineral wax and Bermudez asphalt; amorphous mineral wax, beeswax, and Bermudez asphalt; amorphous mineral wax, paraffin, and Bermudez asphalt; amorphous mineral wax, lead oleate, and Bermudez asphalt; amorphous mineral wax, copper oleate, and Bermudez asphalt; wool grease, lead oleate, and petroleum asphalt; amorphous mineral wax and Japan wax; amorphous mineral wax and ceresin; amorphous mineral wax and rosin; amorphous mineral wax and candelilla wax; and paraffin and rosin.

It was found that when these treatments were applied to 12-ounce United States standard army gray duck all of the treatments increased the water resistance sufficiently for use as permanent tops or covers which lie smooth, such as wagon tops, shock and hay covers, tents, and awnings. When lead oleate was included in the treatment the water resistance was increased. All three of the treatments having a rating of 100 per cent as regards water resistance contained lead oleate. Bermudez asphalt was also an effective constituent in these formulas, and was fully as good as lead oleate. Further experiments indicated that there is no material difference in this respect between Bermudez asphalt and petroleum asphalt.

Copper oleate was not so effective a waterproofing agent as lead oleate. Beeswax was much more effective than any of the other hard waxes used, including paraffin and ceresin. Amorphous mineral wax was a better waterproofing agent than paraffin. Wool grease was found to be a useful constituent in formulas containing other waterproofing agents. Other results indicated that the substitution of amorphous mineral wax for wool grease in this formula did not decrease its water resistance.

In the laboratory studies it was found that both the funnel and spray tests applied to new treated duck indicated higher water resistance than is actually found in service. The waterproofing treatments which proved most serviceable on 12-ounce United States standard army gray duck also gave higher results by the funnel test. However, not all treatments showing a high rating by the funnel test proved highly serviceable in those cases where water lay for some time on the canvas. When a treatment secured the maximum rating by both the funnel and spray tests it also received a high rating in the service test. After a year's exposure, the ratings by the spray test were still high and were in general harmony with the observations made on sloping and flat sections of the canvas. In the formulas used, paraffin, Japan wax, ceresin, candelilla wax, and rosin were not effective waterproofing materials on canvas. Although formulas containing these materials may have rated high by both the funnel and spray tests when the canvas was new they lacked durability. It is concluded that neither the funnel test nor spray test alone is an infallible indication of the serviceability of a waterproofing treatment for canvas.

A. S. A. E. and Related Activities

A.S.A.E. Exhibit at Tractor Show

THE American Society of Agricultural Engineers again distinguished itself by the very attractive educational exhibit at the Seventh National Tractor and Power Farming Show held at Minneapolis the week of February 6 to 11. Especial credit is due for the arrangement and success of this exhibit to Prof. William Boss, head of the department of agricultural engineering, at the University of Minnesota, and his associates. The various charts, illustrations, and other educational material which constituted the greater part of the exhibit was furnished by the division of agricultural engineering of the U. S. Department of Agriculture and by the agricultural engineering departments of the following state agricultural colleges: Minnesota, Nebraska, Iowa, Pennsylvania, Mississippi, Massachusetts, Virginia, Ohio, California, and Wisconsin. The charts for the most part were confined to the various phases of the application of mechanical power to farming.

The Society also had on exhibit copies of AGRICULTURAL ENGINEERING and the A. S. A. E. Transactions with specific reference to that portion of the contents of the Society publications relating to power farming.

A model of an internal-combustion engine used for classroom work by the division of agricultural engineering at the Minnesota college of agriculture was also on display in the A. S. A. E. booth, as well as the disk recleaner described by Robert H. Black in the leading article in this issue.

Conference on Commercial Engineering

THE United States Commissioner of Education is calling a second public conference on commercial engineering on behalf of a committee on commercial engineering appointed by him to investigate business training of engineers and engineering training for students of business.

The conference will be held May 1 and 2 at the Carnegie Institute of Technology in Pittsburgh. President Arthur Hamerschlag of this institution is a member of the committee which is composed of prominent deans of schools of engineering, and of commerce in our larger universities, and of engineers and business men who are nationally known for their interest in the reduction of the costs of production, distribution, transportation, etc., through better training in schools and colleges of the personnel of industry and commerce.

The conference will be open to the public. Invitations to appoint delegates to the Pittsburgh conference, however, will be sent by the Commissioner of Education to commercial and trade organizations, engineering and scientific societies, educational institutions and other groups as well as to prominent individuals.

Owing to the timeliness of the subject, the conference in Pittsburgh will even have greater national significance than the first public conference on this question, which was held in Washington two and one-half years ago under the direction of this committee on commercial engineering.

Kansas City Engineering Congress

MEMBERS of the American Society of Agricultural Engineers are cordially invited to participate in an engineering congress devoted to a symposium on the petroleum industry to be held in Kansas City, Missouri, on March 6 and 7, 1922, under the auspices of the Engineering Club of Kansas City and local sections of the American Society of Mechanical Engineers in the several states adjacent to Kansas City. The subject involves not only every branch of engineering, but also geology and chemistry. The subjects to be discussed are the geology of gas and oil, drop bits and rotary methods of drilling, transportation with special reference to pumps and pipe lines, mechanical methods of refining, and chemical processes involved, products of oil and their uses, the oil supply of the world, the financial side of the oil industry, gasoline from casing-head gas and the processes involved, and accounting methods in the oil industry. This congress affords an opportunity to bring together for the first time the various groups of technical men in the mid-west territory. Invitations are extended to all chemists, geologists, engineers, and those interested in the financing of the petroleum industry, and especially to the members of leading engineering and allied organizations, to the members of the various engineering college alumni associations of the United States contiguous to Kansas City, Missouri.

All members of this Society who plan to attend this congress should get in touch with R. E. Van Atta, Secretary, Engineers Club of Kansas City, 509 K. C. S. Railway Building, Kansas City, Missouri.

Get Together at Minneapolis

DURING the Seventh National Tractor and Power Farming Show held at Minneapolis the second week in February a very interesting get-together meeting of members of the American Society of Agricultural Engineers and others interested in the activities of the Society was arranged by the agricultural engineering staff at the Minnesota college of agriculture. On the evening of February 8 between twenty-five and thirty members of the Society and others met for dinner at the college dining hall at University Farm, after which several interesting informal talks were enjoyed. Prof. William Boss, head of the department of agricultural engineering at Minnesota, presided. The following gave interesting and timely talks on various phases of agricultural engineering: Prof. J. B. Davidson, head of the department of agricultural engineering at the Iowa State College, a charter member of the American Society of Agricultural Engineers and generally recognized as the dean of agricultural engineers; David Beecroft, directing editor of the publications of the Class Journal Company and past president of the Society of Automotive Engineers; F. N. G. Kranich, manager of the agricultural implement bearing division of the Hyatt Roller Bearing Company and author of a new and very valuable book on farm machinery design and operation; I. W. Dickerson, agricultural engineering editor of five leading farm publications; and F. W. Duffee, assistant professor of agricultural engineering in charge of farm power machinery at the University of Wisconsin. The Secretary spoke briefly on financial and other conditions of the Society.

At K.S.A.C.

INASMUCH as there were only a few members at the time (1920) the agricultural engineering students of the Kansas State Agricultural College first met with the mechanical engineers section for the purpose of carrying on seminar. During the fall of 1920, however, the agricultural engineers

held a meeting and decided that they could get more out of the course and become better acquainted and better organized by meeting separately, so on November 18 a committee was appointed to draw up a constitution and on December 2 the constitution was adopted and the officers elected. Since then the student branch of the A. S. A. E. at K. S. A. C. has met every Thursday afternoon, except on the fifth Thursday, of each month. The freshmen meet with the upper classmen every second Thursday and all the engineers of the K. S. A. C. have a general seminar the fourth Thursday.

During the course of the year many interesting and instructive meetings have been held. For example, the meeting on March 3 devoted considerable time to the discussion of concrete construction on the farm. On March 17 the subject "Standardization of Farm Equipment" was discussed, and at the third meeting in March (March 24) the main feature of the program was "Factory Distribution of Machinery." At the meeting on April 21 the annual meeting of the Society in Chicago was the topic of discussion. The two meetings in May, May 5 and May 19, the subjects "Why an Agricultural Engineer" and "Agricultural Economics" occupied the chief attention at the respective sessions.

The meetings during the fall semester of 1921 have consisted of the election of officers for the new year, a discussion of the advisability of changing the name of the department of the K. S. A. C. from "farm engineering" to "agricultural engineering." The meeting on November 19 took up two important subjects for discussion, namely, silos and combined harvesters.

The K. S. A. C. student branch of the Society have contributed several articles on agricultural engineering to "The Kansas State Engineer," the college engineering publication.

Student Branch Doings

Unique Frolic at Ohio State

A PRECEDENT was established on the evening of October 15 at Ohio State University in an event which will be made an annual affair on the college calendar—an all-ag-college frolic and weiner roast, writes B. Parker Hess, president of the student branch of the American Society of Agricultural Engineers at the Ohio State University.

The idea was conceived in the student branch of the American Society of Agricultural Engineers at the University and presented to the newly formed all-ag executive committee composed of representatives of the societies of the agricultural college. The A. S. A. E. student branch, having conceived the idea, were looked upon as the "ring leaders;" and they performed their part well.

A suitable place on the aviation field was selected. An abundance of dry timber could be had along the river; so a flat-top wagon was coupled to a Samson tractor; and soon a load of husky "ag. engineers" were on their way in the search of wood. Eight large loads of wood were used to make a log heap about three hundred feet long on the chosen spot.

Tickets, admitting one couple, were sold. These tickets entitled a couple to a generous helping of weiners, buns, pickles, marshmallows, and coffee which were enjoyed around the glowing log heaps.

When the fires smoldered, lights were needed and herein lies the feature of the evening. Sixteen-foot uprights were arranged in the form of a U. These uprights placed 20 feet apart in the row carried electric-light wires. Between uprights a light bulb was placed.

The electrical-engineering department of the engineering college loaned a 110-volt electric generator. This was mounted on a flat-top hay wagon and hauled to the scene of the frolic by a 15-27 Case tractor. Here the Case tractor was belted to the generator and when evening came, a continuous flood of white light was produced until after 10:30 P. M. This was quite novel and gave an agricultural touch to the scene.

Three hundred were present in spite of the fact that many other social functions were scheduled. All enjoyed a good evening and hope for a similar evening every succeeding year. Also, all were loud in their praise of the A. S. A. E. student branch who conceived the idea and made it possible.

F.A.E.S. Progress

ROUNDING out a year of improved organization, substantial accomplishment and strengthened purpose, the American Engineering Council of the Federated American Engineering Societies held its first annual meeting at the Cosmos Club, Washington, January 5 and 6, Dean Mortimer E. Cooley of the University of Michigan, president of the Council, presiding. Officers were chosen, the work of the past year reviewed and discussed, action taken on important matters of public and technical service, new financial arrangements put into effect, committees named, new policies sanctioned and old ones reshaped, and a broad and definite program outlined for the next twelve months. A leading event of the meeting was a dinner in honor of Herbert Hoover, who addressing the members of the Council and their guests at the University Club, praised the work of the Committee on Elimination of Waste in Industry as a great and lasting public service, pointed the way for new engineering effort in the public interest, and expressed renewed devotion to the ideals of the Council. Resolutions of appreciation of the service of the new Secretary of Commerce were presented to Mr. Hoover.

Dean Cooley in opening the sessions declared his confidence in the future of the Council and outlined generally his plans for more effective organization to be carried out in cooperation with the executive secretary, L. W. Wallace. Encouraging reports over the outlook for accretions to membership were reported to the Council. The secretary's report showed that on January 1, 1921, the membership of the F. A. E. S. was composed of six national and fourteen state and local societies, a total of twenty on December 31, 1921, there were eight national and twenty state and local societies, a gain of eight member societies.

Conditions in the mining industry, as stated by the president of the American Institute of Mining and Metallurgical Engineers, were responsible for a reduced contribution by the Institute to the Council for the coming year. As a consequence, the assessments levied upon the other member societies were cut down proportionately. This was accomplished by constitutional amendment. Sharp reductions in the budget were thus made necessary, and, though the Council begins the year with a scarcity of funds, assurances have been given of additional financial aid in the near future.

"The financial situation is not such as to cause alarm," said Secretary Wallace in his report. "Careful management and the results to be expected from an active campaign for new members should enable the Federation to perform its work for 1922 without a deficit."

The balloting for officers resulted in the reelection as vice-presidents of Dexter S. Kimball, dean of the college of engineering, Cornell University, and J. Parke Channing of New York. W. W. Varney of New York was again chosen treasurer. L. W. Wallace was reelected executive secretary by unanimous action of the Executive Board.

"It is our conception," said Secretary Wallace, "that there is no more important work for the Federation to do than to inform engineers and the public as to the valuable work that the engineer is doing and to indicate to all concerned how essential he is to modern civilization."

The Council voted to continue support of the legislation for the relief of the United States Patent Office as embodied

in the Lampert bill. The report of the Council's Patent Committee headed by Edwin J. Prindle of New York described conditions in the Patent Office as alarming.

The Council voted to cooperate in the movement to prepare for cyclical industrial depressions and unemployment by resort to public works project. On this subject the Council received a proposal from Mr. Hoover, and it was decided to open conferences with him to ascertain in what way the Council could best provide effective aid.

Topographic mapping and the establishment of a Department of Public Works were other legislative matters in which the Council decided to continue its support.

Considerable discussion was provoked by the plan to establish a Federation journal which would be sent to every engineer enrolled in the federation. The Publicity Committee made no recommendations and the Council took no definite action. It was generally agreed that some such contact should be established between the Federation and its enrolled membership, but there was diversity of opinion as to its form.

New Members of the Society

MEMBERS

ROY N. TOWL, Towl, Nelson & Schwartz, Civil Engineers, Fourteenth and N Sts., South Omaha, Nebraska.

ASSOCIATE MEMBERS

W. A. ROWLANDS, secretary, Marinette County Land Clearing Association, Wausaukee, Wisconsin.

ARTHUR J. Schwantes, assistant professor of land clearing, division of agricultural engineering, University Farm, St. Paul, Minnesota.

LEE STEWART, Spooner, Wisconsin.

TRANSFER OF MEMBERSHIP GRADE

JAMES T. GIBBS, JR., R. F. D. No. 7, Columbia, Missouri (Student Branch Member to Junior Member).

D. L. JANTZ, Larned, Kansas (Student Branch Member to Junior Member).

M. S. KLINCK, head of department of rural engineering, Rutgers College, New Brunswick, New Jersey (Junior Member to Associate Member).

Applicants for Membership

The following is a list of applicants for membership received since the publication of the December issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for the consideration of the Council prior to their election.

Charles C. Crockatt, chief engineer, Hollow Building Tile Association, Conway Building, Chicago, Illinois.

Henry Raymond Herndon, 909 Southwestern Life Building, Dallas, Texas.

Theodore Frederick Laist, Chicago Representative National Lumber Manufacturers Association, 1613 Harris Trust Building, Chicago, Illinois.

R. B. Lundy, San Jose, California.

Conrad Roger Neff, University Station, Baton Rouge, Louisiana.

Richard G. Peeples, Arizona Equitable Rating Office, 711 Heard Building, Phoenix, Arizona.

Frederick H. Schreiner, Bank of Commerce and Trust Co., Memphis, Tennessee.

Paul Hans Swanson, 152 West Vine Street, Owatonna, Minnesota.

Walter Wallace Weir, University of California, Berkeley, California.

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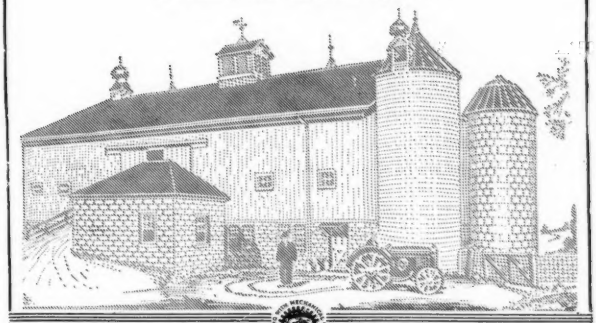

Back Issues of Journal Available

A LIMITED number of copies of all back issues of AGRICULTURAL ENGINEERING, the Journal of the American Society of Agricultural Engineers, with two or three exceptions, are available to those desiring to complete Volumes I and II. The prices of these copies are 20 cents to members of the Society and 30 cents to non-members.

Owing to lack of storage facilities a special effort will be made to dispose of these back issues to individuals and institutions desiring them. Members who lack copies to complete Volumes I and II of their personal files should act quickly if they wish to secure the copies they need. Advise the Secretary promptly of the copies you desire.

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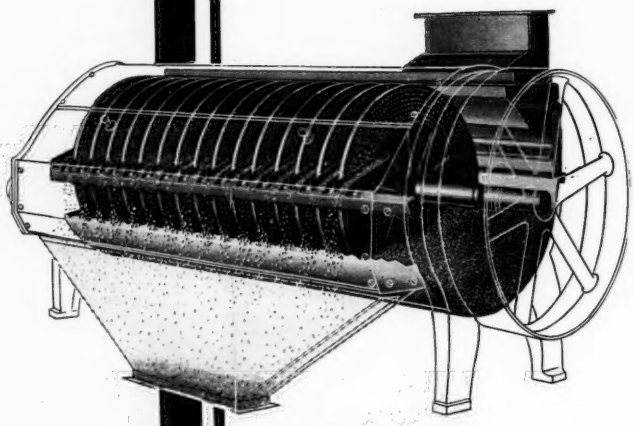

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Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members, as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

The Secretary receives several times each month from The Federated American Engineering Societies a bulletin listing the "positions open" which are reported to the F. A. E. S. Employment Service by member engineering societies. Copies of this bulletin are sent to the "men available" listed below, or other members seeking employment, as soon as received.

Men Available

AGRICULTURAL ENGINEER wants position as experimental agricultural engineer or with some agricultural publication. Graduate, 1918, agricultural college of the University of Illinois. Was editor of the Illinois agricultural students publication in his senior year. For two years employed by an explosives manufacturer as agricultural sales and service man for the State of Wisconsin. At present associated with the land clearing department of the University of Wisconsin. Age 25, married, American. MA-101

AGRICULTURAL AND CHEMICAL ENGINEER, with several years experience in research and experimental work, both in agricultural and chemical lines, desires a position on an agricultural experiment station staff or in some phases of agricultural engineering work. MA-102.

AGRICULTURAL ENGINEER, with M.E. degree and three and a half years experience in charge of the experimental department of one of the large tractor manufacturers doing experimental and development work on tractors; gasoline, kerosene, and alcohol engines; carburetors; magnetos; hot spot manifolds, and lubricating oils, desires employment with someone developing a tractor for general farm work. MA-103

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104

AGRICULTURAL GRADUATE (1916) from the Mississippi A. & M. College with the degree of B.S.A., formerly connected with the U. S. Department of Agriculture, in military service September, 1917 to June, 1919, and more recently a cotton planter, wants a position as instructor in some branch of agriculture. MA-105

AGRICULTURAL ENGINEER wants position in southwest. Graduate of University of Illinois 1915, five years practical experience on Illinois farm with power equipment, two years in charge of the agricultural engineering department New Mexico College of Agriculture; considerable garage experience and service experience on unit power and light plants. Also one summer in Philadelphia battery service station. MA-106

AGRICULTURAL ENGINEER, graduate from the agricultural engineering course of the Iowa State College, who has had a great deal of experience in sewer work and farm building construction in the southern states, is interested in securing employment with a firm specializing on farm structures or farm sanitation. MA-107

AGRICULTURAL ENGINEER, graduate in agriculture at Cornell and trained in mechanical and electrical engineering, at present assistant professor of rural engineering at an agricultural college, wants position in the same or related field. Six years teaching experience and about six years engineering experience with telephones, milking machines, field machinery, concrete pipe making machinery and gas engines. Thoroughly trained in automotive theory and practice, including repair. MA-108